AMENDMENTS TO THE CLAIMS

Please amend the claims as follows.

1. (Currently Amended) A method for determining an axial force acting on each one of a plurality of roller cones on a roller cone drill bit during drilling, comprising:

   calculating, from a geometry of cutting elements on each of the roller cones and an earth formation being drilled by the drill bit, an axial force acting on each of the cutting elements;

   incrementally rotating the bit and recalculating the axial forces acting on each of the cutting elements;

   repeating the incrementally rotating and recalculating for a selected number of incremental rotations; ~~and~~

   combining the axial force acting on the cutting elements on each one of the roller cones; and

   graphically displaying the axial force acting on each one of the plurality of roller cones.

2. (Previously Presented) The method as defined in claim 1 wherein the axial force acting on each of the cutting elements totals an axial force applied to the drill bit.

3. (Previously Presented) The method as defined in claim 2 wherein an incremental axial movement of the drill bit corresponding to the incrementally rotating is adjusted to cause the axial force on each of the cutting elements to total the axial force applied to the drill bit, the axial force acting on each of the cutting elements determined with respect to a predetermined relationship between depth of penetration and axial force applied for the cutting element geometry and the earth formation.

4. (Previously Presented) The method as defined in claim 3 wherein the predetermined relationship is determined by laboratory experiment comprising impressing a cutting element having known geometry onto a selected earth formation, while measuring force on the cutting element and a corresponding depth of penetration of the cutting element into the selected earth formation.

5. (Previously Presented) A method for determining a volume of formation cut by each one of a plurality of roller cones on a drill bit drilling in earth formations, comprising:

selecting bit design parameters, comprising at least a geometry of a cutting element on the drill bit;

selecting an earth formation;

calculating from the selected bit design parameters and the selected earth formation, parameters for a crater formed when each one of a plurality of cutting elements on each of the roller cones contacts the earth formation, the parameters including at least a volume of the crater;

incrementally rotating the bit, and repeating the calculating of the crater parameters for a selected number of incremental rotations; and

combining the volume of each crater formed by each of the cutting elements on each of the roller cones to determine the volume of formation cut by each of the roller cones.

6. (Previously Presented) The method as defined in claim 5 wherein the volume of each of the craters is determined by:

determining an axial force on each of the cutting elements;

calculating, from the axial force on each of the cutting elements, an expected depth of penetration and projected area of contact between each of the cutting elements and the earth formation; and

calculating the volume of each of the craters from the expected depth of penetration and projected area of contact.

7. (Previously Presented) The method as defined in claim 6 further wherein the axial force acting on each of the cutting elements totals an axial force applied to the drill bit.

8. (Previously Presented) The method as defined in claim 7 wherein an incremental axial movement of the drill bit corresponding to the incrementally rotating is adjusted to cause the axial force on each of the cutting elements to total the axial force applied to the drill bit, the axial force acting on each of the cutting elements determined with respect to a predetermined relationship between depth of penetration and axial force applied for the cutting element geometry and the earth formation.

9. (Previously Presented) The method as defined in claim 8 wherein the predetermined relationship is determined by laboratory experiment comprising impressing a cutting element having known geometry onto a selected earth formation, while measuring force on the cutting element and a corresponding depth of penetration of the cutting element into the selected earth formation.

10. (Currently Amended) A method for balancing axial forces acting on each one of a plurality of roller cones on a roller cone drill bit during drilling, comprising:

calculating, from a geometry of cutting elements on each of the roller cones and an earth formation being drilled by the drill bit, an axial force acting on each of the cutting elements;

incrementally rotating the bit and recalculating the axial forces acting on each of the cutting elements;

repeating the incrementally rotating and recalculating for a selected number of incremental rotations;

combining the axial force acting on the cutting elements on each one of the roller cones; and adjusting at least one bit design parameter, ~~and~~

repeating the calculating the axial force, incrementally rotating and combining the axial force, until a difference between the combined axial force on each one of the roller cones is less than a difference between the combined axial force determined prior to adjusting the at least one initial design parameter;

graphically displaying the axial force acting on the plurality of roller cones.

11. (Previously Presented) The method as defined in claim 10 wherein the axial force acting on each of the cutting elements totals an axial force applied to the drill bit.

12. (Previously Presented) The method as defined in claim 11 wherein an incremental axial movement of the drill bit corresponding to the incrementally rotating is adjusted to cause the axial force on each of the cutting elements to total the axial force applied to the drill bit, the axial force acting on each of the cutting elements determined with respect to a predetermined relationship between depth of penetration and axial force applied for the cutting element geometry and the earth formation.

13. (Previously Presented) The method as defined in claim 12 wherein the predetermined relationship is determined by laboratory experiment comprising impressing a cutting element having known geometry onto a selected earth formation, while measuring force on the cutting element and a corresponding depth of penetration of the cutting element into the selected earth formation.

14. (Previously Presented) The method as defined in claim 10 wherein the at least one bit design parameter comprises a number of cutting elements on at least one of the cones.

15. (Previously Presented) The method as defined in claim 10 wherein the at least one bit design parameter comprises a location of cutting elements on at least one of the cones.

16. (Previously Presented) A method for balancing a volume of formation cut by each one of a plurality of roller cones on a drill bit drilling in earth formations, comprising:

selecting bit design parameters, comprising at least a geometry of a cutting element on the drill bit;

selecting an earth formation; calculating from the selected bit design parameters and the selected earth formation, parameters for a crater formed when each one of a plurality of cutting elements on each of the roller cones contacts the earth formation, the parameters including at least a volume of the crater;

incrementally rotating the bit, and repeating the calculating of the crater parameters for a selected number of incremental rotations;

combining the volume of each crater formed by each of the cutting elements on each of the roller cones to determine the volume of formation cut by each of the roller cones; and

adjusting at least one of the bit design parameters, and repeating the calculating the crater volume, incrementally rotating and combining the volume until a difference between the combined volume cut by each of the cones is less than the combined volume determined prior to the adjusting the at least one of the bit design parameters.

17. (Previously Presented) The method as defined in claim 16 wherein the volume of each of the craters is determined by:

determining an axial force on each of the cutting elements;

calculating, from the axial force on each of the cutting elements, an expected depth of penetration and projected area of contact between each of the cutting elements and the earth formation; and

calculating the volume of each of the craters from the expected depth of penetration and projected area of contact.

18. (Previously Presented) The method as defined in claim 17 wherein the axial force acting on each of the cutting elements totals an axial force applied to the drill bit.

19. (Previously Presented) The method as defined in claim 18 wherein an incremental axial movement of the drill bit corresponding to the incrementally rotating is adjusted to cause the axial force on each of the cutting elements to total the axial force applied to the drill bit, the axial force acting on each of the cutting elements determined with respect to a predetermined relationship between depth of penetration and axial force applied for the cutting element geometry and the earth formation.

20. (Previously Presented) The method as defined in claim 16 wherein the at least one bit design parameter comprises a number of cutting elements on at least one of the cones.

21. (Previously Presented) The method as defined in claim 16 wherein the at least one bit design parameter comprises a location of cutting elements on at least one of the cones.

22. – 29. (Cancelled)